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ATMOSPHERIC

TEMPERATURE AS AN ESSENTIAL FACTOR IN THE PROPAGATION

OF

Yellow Fever

BY

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HAVANA, CUBA

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HAVANA



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Few events in medical science have had the privilege of being so carefully and thoroughly investigated by highly competent experts from scientific institutions of different Nations, and under varied conditions of geographical site and tropical surroundings, as have been the findings of the U. S. Army Yellow Fever Commission of Habana in 1900 and 1901, confirmatory of my mosquito theory of yellow-fever transmission. And so unanimous has been the consensus of opinion among all subsequent investigators regarding the fact that the bites of the "*stegomyia calopus*" constitute the regular channel through which the disease is normally transmitted from man to man, that all the Governments directly interested in the matter have agreed to consider that principle as the only sound basis for an efficient prophylaxis of the disease.

The time has come, therefore, when further investigations should be made into the secondary factors which are known either to inhibit or to intensify the faculty possessed by the *stegomyia* of first becoming contaminated with the immature germs contained in the blood of a yellow fever patient and of thereafter inoculating the matured germ to nonimmunes. Above all should our attention be directed to the *modus operandi* of atmospheric temperature which has at all times been held responsible for the yearly alternations of an epidemic and a non-epidemic season in the endemic centres of former days, when the disease was allowed to pursue its natural course unhampered by human interference of any kind.

As far back as 1882 and 1883, having no doubt in my mind as to the fact that the *stegomyia calopus* or *fasciata* was the natural transmitter of yellow fever, I had taken much pains to determine the influence of atmospheric temperature on the functional activity of that species of mosquito, then known in Havana as the *Culex* mosquito (Robineau Desvoidy); and by a series of careful experiments I endeavoured to ascertain for that in-

sect the five temperature-limits which Van Tieghem, in his "Traité de Botanique" (Paris, 1884, p. 88) considers *critical* for seeds and plants, namely:

- Nº 1. A low temperature-limit, below which the external manifestations of life are suspended although vitality persists in a latent condition. I have observed this to occur with the Havana stegomyia when the temperature is lowered to between 15º and 19º C. This would be the limit for "apparent death by cold."
- Nº 2. A high temperature-limit, above which the stegomyia drops into a state of lethargy, apparently dead, but may completely revive in a lower temperature. This is observed to happen when the temperature is raised to 37º or 38º C. This is "apparent death by heat."
- Nº 3. An intermediate temperature-limit, at some point between Nº 1 and Nº 2, at which all the vital functions are accomplished in the most perfect manner. This optimum-limit I have not been able to determine in the adult insect; but taking as a criterion the mean temperature of days when the successive phases of development, from the ovum to the imago, are most rapidly accomplished, I am inclined to place this limit at some point between 29º and 31º C. These being also the mean temperatures which are most frequently recorded during the acme of severe epidemics.
- Nº 4. A still lower temperature, below Nº 1, at which life ceases altogether; this being "real death by cold". I have observed it, in Havana, when the temperature was artificially lowered to -1º C. or -4º C.
- Nº 5. A high temperature-limit, above Nº 2, at which life is also completely extinguished beyond the possibility of revival. This is the limit of "real death by heat", which I have observed in some of my experiments during the winter season, when the temperature was raised to between 39º and 40º C.

But the five temperature-limits scheduled above leave entirely out of consideration precisely the two most essential ones so far as the transmission of yellow fever and the multiplication of the transmitting insect are concerned. I refer to the temperature-limits below and above which the stegomyia may be unable to bite and to suck blood. It might be thought that almost simultaneously with the recovery of its general motility, after having been previously benumbed by excess of heat or of cold, a stegomyia which is seen to fly and to move about with ease or to feed readily on sugar or sweet juices, would be also in a condition to bite and to suck blood. But my personal observations have long since satisfied me that this is not always the case. I have seen occasionally in Havana, during the winter season, stegomyias flying about in the room and others, in captivity, feeding on sugar and flying when the temperature was not above 22º C. I have also seen them drive their sting as far as it could reach into the skin, evidently eager to get a feed of blood, but unable to do so so long as the atmospheric temperature remained below 23º C. Nor have I ever, as far as my records show, witnessed a successful bite by a mosquito of that species, including the sucking of a fair quantity of blood, when the atmospheric temperature was less than 24º C.

From these data I have inferred that the lowest temperature-limit at which, during the winter season, the Havana stegomyia can accomplish such a bite as will enable it to become contaminated from a yellow fever patient or to lay successive batches of ova for the propagation of its own species, lies between 23º and 25º C., a condition of things which obtains in Havana, at certain hours of the day, when the diurnal mean temperature reaches 23º C.

Regarding the *hot* temperature-limit beyond which the stegomyia should be prevented, by excess of heat, from accomplishing a successful bite, I do not believe that it ever occurs, in the shade, in this part of the Island, for all hours of the day; but it is possible that the occurrence of such a limit in the vicinity of the equatorial line may have contributed to retard the extension of the yellow fever infection, along the Atlantic coasts of America, from the Northern to the Southern hemisphere.

My surmise that during the winter season in Havana, a diurnal mean temperature from 23º C. upwards should be considered as characteristic of days when the local stegomyias are in a condition to become infected and to transmit the yellow fever infection, received a practi-

cal confirmation in the course of an investigation which I undertook in 1893.—As far back as our yellow fever statistics reached at that time, and more particularly regarding the 13 years' period from 1880 to 1892, only once could I find in the records of the Belen Observatory an entire month without a single day showing a diurnal mean temperature as high as 23°C . This happened in the month of January 1886; and in the following month (February 1886) there had been only two such days, one with a mean temperature of 23° and another of 24°C .—And coincidentally with these exceptionally low mean temperatures, I found, also as a unique exception in a long series of years, that during the first five months of that year (1886) only two cases with no deaths had been recorded at the Havana Military Hospital, while in the Civil population (where only the deaths were recorded) only eight deaths had occurred (4 in January, two in April and two in May) with the circumstance that the 4 deaths in January had occurred in the first week of that month so that the infection in these 4 must have been acquired in the preceding month. Such a marked decline in the number of yellow fever invasions was an unprecedented event in Havana, and was all the more remarkable inasmuch as no measures had been taken to control the propagation of the disease or to prevent its importation from outside. In fact it virtually amounted to an almost complete extinction of the infection through purely natural causes.

In view of these remarkable facts I have drawn separate charts for each of the 13 years (1880 to 1892) referred to in the preceding paragraph and have appended them to this paper for the benefit of members who are particularly interested in the subject; but their construction being different from other charts of this kind, I beg leave to explain briefly the plan on which they have been drawn.

Bearing in mind that yellow-fever patients infected in the last 4 days of a given calendar month, as a rule, are only taken sick or reported in the following month, and my purpose being to show the mean temperatures of days of possible infection, I have included in each column corresponding to the yellow fever invasions recorded at the Military Hospital in a given month the mean temperatures of the last 4 days of the preceding month, omitting on the other hand those of the 4 last days of the calendar month under consideration. Moreover the mean temperatures are not tabulated in their order of succession but merely distributed so as to show in each column the number of days which have shown a certain degree (centigrade) including all decimals between it and the next degree above.

These charts clearly show the close relation which formerly existed in Havana between the number of days of possible infection which had presented mean temperatures favourable for the functional activity of the *stegomyia calopus* and the number of yellow fever invasions recorded at the Military hospital.

The three hottest years of the series (1880, 1882 and 1883,) were the only ones in which upwards of one thousand yellow fever invasions were recorded at the Military hospital. And, in each individual year, the calendar month in which the greatest number of yellow fever invasions had occurred proved almost invariably to have been the one in which the days of possible infection with mean temperatures between 27° and 31°C . had been most numerous.

On the other hand, the year 1886 which showed lower mean temperatures than any other in the series, was at the same time remarkable for the small number of yellow fever invasions during the first five months of that year; an event which could only be attributed to the low mean temperatures recorded in January and February, leading to an almost complete extinction of the infection from purely natural causes.

One of my objects in publishing these data has been to solicit similar ones from other yellow fever centres, so that it may be known to what extent the *stegomyia calopus* is able to accommodate itself to different temperature conditions under the influence of climatic variations. Indeed I cannot but attach considerable importance to the study of the habits of the *stegomyia* as well as of other insects which are known to transmit infectious diseases, being of opinion that without such knowledge our means of control must always be imperfect.

TABLES SHOWING THE RELATION

BETWEEN THE MEAN TEMPERATURES OF DAYS OF POSSIBLE INFECTION AND THE NUMBER OF YELLOW FEVER
INVASIONS AND DEATHS RECORDED AT THE HAVANA MILITARY HOSPITAL
DURING EACH CALENDAR MONTH IN A SERIES OF THIRTEEN YEARS (FROM 1880 TO 1892).

CHART No. 1
1880

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Days of possible infec- tion.....	28/12—79 to 27/1—80	28/1 to 25/2	26/2 to 27/3	28/3 to 26/4	27/4 to 27/5	28/5 to 26/6	27/6 to 27/7	28/7 to 27/8	28/8 to 26/9	27/9 to 27/10	28/10 to 26/11	27/11 to 27/12	
Centigrade scale													
32° — 33°							2 ds. 4	1 d. 15	1 d. 6				2
31° — 31°9							14	15	6				8
30° — 30°9							7	11	17				42
29° — 29°9							4	2	3	2 ds. 15			44
28° — 28°9					1 d. 5	7	4	2	1	5 ds. 11			47
27° — 27°9			3 ds. 7	3 ds. 9	10	6		2	2	6		2 ds. 9	54
26° — 26°9			9	8	9	2				8	9		60
25° — 25°9	2 ds. 9	2 ds. 9	8	5	6						4	2	43
24° — 24°9	17	12	4	2							0	4	39
23° — 23°9	1	3		3							1	4	12
22° — 22°9	2	1										5	8
21° — 21°9		2										3	5
20° — 20°9												2	2
19° — 19°9													
18° — 18°9													
17° — 17°9													
16° — 16°9													
15° — 15°9													
14° — 14°9													
Military hospital													
Yellow fever. { Cases....	18	17	25	65	61	259	384	336	205	62	16	22	1470
Deaths..	4	4	7	30	18	88	234	84	39	32	8	10	558
Civil population													
Yellow fever. Deaths...	11	5	13	14	22	19	88	78	32	0	11	4	297

CHART No. 2

1881

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Days of possible infection { 28/12—80 to 27/1—81		28/1 to 24/2	25/2 to 27/3	28/3 to 26/4	27/4 to 27/5	28/5 to 26/6	27/6 to 27/7	28/7 to 27/8	28/8 to 26/9	27/9 to 27/10	28/10 to 26/11	27/11 to 27/12	
Centigrade scale													
32° — 32°9						2ds. 4	1 d. 12	1 d. 16					3
31° — 31°9						16	10	7	6ds.				17
30° — 30°9						3	5	4	10				48
29° — 29°9				1 d. 3	2ds. 16	3	2	3	10				28
28° — 28°9			3ds. 6	4	11	2	1	3	10	15ds. 15	2ds. 19		57
27° — 27°9			1	4	1	3			4	1	5		66
26° — 26°9	6 ds. 5		2	5	1						1	6 ds. 6	24
25° — 25°9	5	5ds. 10	4	3	1						1	6	25
24° — 24°9	11	7	3	4							2	7	37
23° — 23°9	5	4	3	3							0	11	30
22° — 22°9	1	2	5	3							1	1	15
21° — 21°9	0	2	2	3									7
20° — 20°9	2		5										7
19° — 19°9	1												1
18° — 18°9													
17° — 17°9													
16° — 16°9													
15° — 15°9													
14° — 14°9													
Military hospital													
Yellow fever. { Cases.... Deaths...	6 4	4 1	10 3	4 4	7 4	54 27	252 67	74 9	209 41	115 8	25 3	22 8	782 179
Civil population													
Yellow fever. Deaths...	4	2	0	2	0	11	29	66	54	31	32	27	258

CHART No. 3

1882

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Days of possible infection.....	28/12--81 to 27/1--82	28/1 to 24/2	25/2 to 27/3	28/3 to 26/4	27/4 to 27/5	28/5 to 26/6	27/6 to 27/7	28/7 to 27/8	28/8 to 26/9	27/9 to 27/10	28/10 to 26/11	27/11 to 27/12	
Centigrade scale													
32°	.....	.....	.....	.....	.....	2 ds.	.....	1 d.	.....	.....	.....	.....	2
31°	.....	.....	.....	.....	1 d.	3	1 d.	1 d.	.....	.....	.....	.....	6
30°	.....	.....	.....	2 ds.	0	5	7	2	.....	.....	.....	.....	16
29°	.....	.....	.....	2	5	12	16	13	7 ds.	.....	.....	.....	55
28°	.....	.....	.....	5	0	7	6	10	14	2 ds.	.....	.....	44
27°	.....	.....	1 d.	6	11	1	1	2	8	16	3 ds.	.....	49
26°	.....	.....	1	6	13	.....	.....	3	0	7	4	.....	34
25°	.....	5 ds.	9	5	1	.....	.....	.....	1	6	4	.....	34
24°	9 ds.	14	13	0	.....	.....	.....	.....	.....	.....	8	11	55
23°	13	6	3	3	.....	.....	.....	.....	.....	.....	1	2	39
22°	3	2	2	1	.....	.....	.....	.....	.....	.....	1	1	11
21°	1	1	2	.....	.....	.....	.....	.....	.....	.....	1	6	6
20°	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	6	10
19°	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	2
18°	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1
17°	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1
16°	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15°	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14°	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Military hospital													
Yellow fever. { Cases.....	6	3	4	10	130	347	270	100	85	81	80	39	1155
Deaths..	0	1	2	4	49	85	76	34	33	45	32	16	377
Civil population													
Yellow fever. Deaths...	9	10	13	15	34	92	119	29	24	11	8	7	381

CHART No. 4

1883

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Days of possible infection {	28/12-82 to 27/1-83	28/1 to 24/2	25/2 to 27/3	28/3 to 26/4	27/4 to 27/5	28/5 to 26/6	27/6 to 27/7	28/7 to 27/8	28/8 to 26/9	27/9 to 27/10	28/10 to 26/11	27/11 to 27/12	
Centigrade scale													
32° — 32°9				1 d.		6 ds.	4ds.	2 ds.					13
31° — 31°9				3	1 d.	10	11	17	1 d.	1 d.			45
30° — 30°9				1	5	6	10	9	12	10			53
29° — 29°9				12	11	5	5	1	10	7	5 ds.		58
28° — 28°9			2 ds.	4	10	3	1	2	7	7	8		44
27° — 27°9			1	4	4					6	11		43
26° — 26°9		14 ds.	4	4	4						5	7 ds.	46
25° — 25°9		14	5	1							1	13	32
24° — 24°9			9	3								5	18
23° — 23°9	6		8	1								2	6
22° — 22°9	4		2									3	4
21° — 21°9	2											0	1
20° — 20°9	1											1	2
19° — 19°9	1												
18° — 18°9													
17° — 17°9													
16° — 16°9													
15° — 15°9													
14° — 14°9													
Military hospital													
Yellow fever. { Cases.....	18	32	55	56	155	298	417	127	17	32	18	10	1235
Deaths....	8	10	21	32	71	154	132	86	14	12	11	9	560
Civil population													
Yellow fever. Deaths....	5	1	1	2	6	9	42	167	37	63	42	36	411

CHART No. 5

1884

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Days of possible infection { 28/12-83 to 27/1-84		28/1 to 25/2	26/2 to 27/3	28/3 to 26/4	27/4 to 27/5	28/5 to 26/6	27/6 to 27/7	28/7 to 27/8	28/8 to 26/9	27/9 to 27/10	28/10 to 26/11	27/11 to 27/12	
Centigrade scale													
32° — 32°9.....													8
31° — 31°9.....													38
30° — 30°9.....													51
29° — 29°6.....													51
28° — 28°9.....													50
27° — 27°9.....													43
26° — 26°9.....													53
25° — 25°9.....													37
24° — 24°9.....													16
23° — 23°9.....													6
22° — 22°9.....													5
21° — 21°9.....													4
20° — 20°9.....													2
19° — 19°9.....													2
18° — 18°9.....													
17° — 17°0.....													
16° — 16°9.....													
15° — 15°9.....													
14° — 14°9.....													
Military hospital													
Yellow fever. { Cases.....	7	7	22	36	64	90	108	82	25	8	4	6	459
Deaths.....	5	2	7	19	27	30	57	36	13	4	0	4	204
Civil population													
Yellow fever. Deaths.	24	15	2	16	30	37	73	66	27	17	9	3	319

CHART No. 6

1885

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Days of possible infection { 28/12—84 to 27/1—85		29/1 to 24/2	25/2 to 27/3	28/3 to 26/4	27/4 to 27/5	28/5 to 26/6	27/6 to 27/7	28/7 to 27/8	28/8 to 26/9	27/9 to 27/10	28/10 to 26/11	27/11 to 27/12	
Centigrade scale					1 d.	1 d.	7 ds.	1 d.					
32° — 32°9					1		16	15					1
31° — 31°9					2	9			2 ds.				10
30° — 30°9					3	9	7	9	12				44
29° — 29°9					9	3	0	2	7	3 ds.			43
28° — 28°9				2 ds.	9	2	1	3	7	6			29
27° — 27°9			3 ds.	11	9	2		1	7	8			47
26° — 26°9			2	11	5	2			2	4	2 ds.	1 d.	
25° — 25°9	6 ds.	2 ds.	5	6	0	3				7	2	1	38
24° — 24°9	11	3	6		1					3	8	0	43
23° — 23°9	7	4	9								9	4	35
22° — 22°9	3	6									4	3	25
21° — 21°9	3	8	4								2	9	26
20° — 20°9	1	4	2								2	6	15
19° — 19°9		0									0	2	2
18° — 18°9		0									1	2	3
17° — 17°9		1										1	2
16° — 16°9												1	1
15° — 15°9												0	0
14° — 14°9												1	1
Military hospital													
Yellow fever. { Cases....	5	2	1	3	6	2	40	24	25	6	4	2	120
Deaths... }	3	2	1	2	4	2	12	21	15	3	0	1	66
Civil population													
Yellow fever. Deaths...	3	1	1	0	0	2	3	11	19	40	23	6	109

CHART No. 7

1886

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Days of possible iniection.....	28/12--85 to 27/1--86	28/1 to 24/2	25/2 to 27/3	28/3 to 26/4	27/4 to 27/5	28/5 to 26/6	27/6 to 27/7	28/7 to 27/8	28/8 to 26/9	27/9 to 27/10	28/10 to 26/11	27/11 to 27/12	
Centigrade scale													
33°						1 d.	1 d.		2 ds.				1
31°						1	2		0				4
30°						2	16	4 ds.					8
29°					2 ds.	8		12	8				46
28°					7	14	6	9	15	5 ds.			57
27°			1 d.		6	1	5	4	2	10			34
26°			3	3 ds.	9	1	0	2	3	8	4 ds.		32
25°			4	1		1	0			5	10		37
24°		1 d.	7	7	6	1	0			3	8	2 ds.	32
23°		1	4	11	1	1	1				7	9	37
22°		6	3	3							1	10	32
21°	4 ds.	1	6	1								10	28
20°	9	1	1	1							1	6	23
19°	7	8	1	1								3	16
18°	4	4	2	3								1	8
17°	1	6											4
16°	4	0											1
15°	0	1											1
14°	1												1
13°	1												
Military hospital													
Yellow fever. { Cases.....	0	1	1	0	0	8	27	36	30	14	7	6	130
Deaths....	0	0	0	0	0	1	4	9	15	4	1	1	35
Civil population													
Yellow fever. Deaths....	4	0	0	2	2	13	30	32	22	12	8	6	131

CHART No. 8

1887

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Days of possible infection.....	28/12—86 to 27/1—87	28/1 to 24/2	25/2 to 27/3	28/3 to 26/4	27/4 to 27/5	28/5 to 26/6	27/6 to 27/7	28/7 to 27/8	28/8 to 26/9	27/9 to 27/10	28/10 to 26/11	27/11 to 27/12	
Centigrade scale													
32° — 32°9.....							5ds. 16	11ds. 15		1 d. 2			17
31° — 31°9.....							7	4		3ds. 14			41
30° — 30°9.....							2	1		5			46
29° — 29°9.....							0			9	1 d.		54
28° — 28°9.....							1			12	3		33
27° — 27°9.....			2ds. 1	2	6	6				1	8	2ds.	31
26° — 26°9.....			1	1	4	3				1	4	10	44
25° — 25°9.....		7ds. 13	6	7		1					12	8	48
24° — 24°9.....	1 d. 2	7	9	4							0	6	21
23° — 23°9.....	8	1	5	2							1	4	16
22° — 22°9.....	7		6	1							1	1	5
21° — 21°9.....	3		0										3
20° — 20°9.....	2		1										2
19° — 19°9.....	2												2
18° — 18°9.....	2												2
17° — 17°8.....	2												2
16° — 16°9.....	2												2
15° — 15°9.....	2												
14° — 14°9.....													
Military hospital													
Yellow fever. { Cases.....	8	8	13	30	50	120	175	79	55	36	29	20	623
Deaths..	3	2	4	11	18	30	58	31	22	12	9	8	238
Civil population													
Yellow fever. Deaths..	3	4	4	10	34	35	51	42	17	23	15	7	245

CHART No. 9

1888

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Days of possible infection { 28/12-87 to 27/1-88		28/1 to 25/2	26/2 to 27/3	28/3 to 26/4	27/4 to 27/5	28/5 to 26/6	27/6 to 27/7	28/7 to 27/8	28/8 to 26/9	27/9 to 27/10	28/10 to 26/11	27/11 to 27/12	
Centigrade scale													
32° — 32°9								2 ds.					2
31° — 31°9							8 ds.	12					21
30° — 30°9					1 d.	7 ds.	14	14	10 ds.	1 d.			47
29° — 29°9					2	7	4	2	9	3	1 d.		29
28° — 28°9				1 d.	8	12	2	1	7	18	5		56
27° — 27°9			3 ds.	0	6	4	2		4	5	8		42
26° — 26°9		2 ds.	3	8	8		2			4	8		46
25° — 25°9		7	4	15	4		1				3		39
24° — 24°9		4	4	6	4						1	8 ds.	23
23° — 23°9	10 ds.	5	1		1						3	3	30
22° — 22°9	12	5	7								2	9	16
21° — 21°9	7	5	6								1	4	10
20° — 20°9	0	5	3								0	4	3
19° — 19°9	2	1	1								1	1	0
18° — 18°9												0	2
17° — 17°9												2	
16° — 16°9													
15° — 15°9													
14° — 14°9													
Military hospital													
Yellow fever. { Cases	9	12	19	55	60	134	209	226	123	73	54	14	988
Deaths...	5	4	11	22	22	25	53	64	44	17	17	4	288
Civil population													
Yellow fever. Deaths...	4	2	4	4	5	8	24	52	18	30	21	22	194

CHART NO. 10

1889

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Days of possible infection..... {	28/12-88 to 27/1-89	28/1 to 24/2	25/2 to 27/3	28/3 to 26/4	27/4 to 27/5	28/5 to 26/6	27/6 to 27/7	28/7 to 27/8	28/8 to 26/9	27/9 to 27/10	28/10 to 26/11	27/11 to 27/12	
Centigrade scale													
32° — 32°9						8 ds.	6 ds.	5 ds.	3 ds.				22
31° — 31°9						8	18	12	11	2 ds.			51
30° — 30°9					5 ds.	6	5	9	11	5			42
29° — 29°9					13	4	1	4	3	2	8 ds.		40
28° — 28°9					5	4	1	1	2	10	13		48
27° — 27°9					6					6	5	2 ds.	30
26° — 26°9		2 ds.		1 d.	1					5	3	8	45
25° — 25°9		3		3	13					0	1	10	34
24° — 24°9	3 ds.	2	2 ds	4	6					1		6	32
23° — 23°9	15	1	6	6	1							5	14
22° — 22°9	6	3	8	5	1								3
21° — 21°9	4	8	11	2									4
20° — 20°9	1	5	3										
19° — 19°9	1	1	1										
18° — 18°9	1	3											
17° — 17°9													
16° — 16°9													
15° — 15°9													
14° — 14°9													
Military hospital													
Yellow fever. { Cases....	14	13	13	22	26	77	104	101	34	6	21	8	439
Deaths..	3	3	2	4	8	23	23	30	10	4	6	4	120
Civil population													
Yellow fever. Deaths..	30	9	17	6	11	26	38	53	36	21	22	10	279

CHART No. II

1890

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Days of possible infection { 28/12-89 to 27/1-90		28/1 to 24/2	25/2 to 27/3	28/3 to 26/4	27/4 to 27/5	28/5 to 26/6	27/6 to 27/7	28/7 to 27/8	28/8 to 26/9	27/9 to 27/10	28/10 to 26/11	27/11 to 27/12	
Centigrade scale							1 d.						
32° — 32°9					2 ds.		8						1
31° — 31°9					2	13 ds.	14	3 ds.	4 ds.				10
30° — 30°9					7	11	5	18	11	3 ds.			36
29° — 29°9					7	1	2	7	8	16			61
28° — 28°9					10	1	1	1	6	4			42
27° — 27°9					3	2	1	2	1	2	6 ds.		40
26° — 26°9			1 d.	1 d.		2		2	1	1	11	1 d.	49
25° — 25°9			0	8							7	6	49
24° — 24°9			3	16							5	7	44
23° — 23°9		3 ds.	7	4							1	8	17
22° — 22°9		10	4	4								4	5
21° — 21°9		12	4	1								4	7
20° — 20°9		3	5									1	2
19° — 19°9			1										1
18° — 18°9			3										
17° — 17°9			1										
16° — 16°9			1										
15° — 15°9			1										
14° — 14°9													
Military hospital													
Yellow fever. { Cases..... Deaths....	7 2	11 2	10 3	26 8	70 15	151 32	188 42	179 32	20 12	19 9	17 7	6 2	704 166
Civil population													
Yellow fever. Deaths....	9	2	1	4	11	12	31	28	20	22	16	10	166

CHART No. 12

1991

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Days of possible infection.....	28/12—90 to 27/1—91	28/1 to 24/2	25/2 to 27/3	28/3 to 26/4	27/4 to 27/5	28/5 to 26/6	27/6 to 27/7	28/7 to 27/8	28/8 to 26/9	27/9 to 27/10	28/10 to 26/11	27/11 to 27/12	
Centigrade scale							1 d. 4						1 4
32° — 32°9						1 d.	9	6ds.					16
31° — 31°9						15	9	17					48
30° — 30°9					1 d.	13	6	3	6ds.				37
29° — 29°9					0	6	1	4	15				22
28° — 28°9					5	1	1	1	7	3ds.			35
27° — 27°9				2ds.	10	1	1	1	1	10		1 d.	60
26° — 26°9		1 d.	2ds.	7	9				1	11	11ds.	3	64
25° — 25°9		8	9	5	6					6	10	13	28
24° — 24°9	2ds.	10	12	3						1	8	7	17
23° — 23°9	1	6	2	2							1	5	15
22° — 22°9	5	1	3	0									8
21° — 21°9	10	1	2	0									7
20° — 20°9	7	1	0	0									2
19° — 19°9	3		1	3									1
18° — 18°9	2												
17° — 17°9	1												
16° — 16°9													
15° — 15°9													
14° — 14°9													
Military hospital													
Yellow fever. } Cases.....	15	16	8	5	12	104	243	188	135	83	49	24	882
Deaths.. }	6	8	3	1	3	28	50	43	38	14	11	7	212
Civil population													
Yellow fever. Deaths..	5	3	1	4	4	16	13	23	26	23	16	11	145

CHART NO. 13

1892

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
Days of possible infection {	28/12--91	28/1	26/2	28/3	27/4	28/5	27/6	28/7	28/8	27/9	28/10	27/11	
to {	27/1--991	25/2	27/3	26/4	27/5	26/6	27/7	27/8	26/9	27/10	26/11	27/12	
Centigrade scale													
32°							2 ds.		1 d.				3
31°							16	11 ds.	6				37
30°							10	13	9				48
29°							2	3	12	8 ds.			51
28°							1	4	2	17	6 ds.		56
27°										4	4	2 ds.	23
26°										1	5	8	33
25°										1	4	5	33
24°											9	10	34
23°											0	5	26
22°											2	1	12
21°													6
20°													3
19°													1
18°													
17°													
16°													
15°													
14°													
Military hospital													
Yellow fever. {	24	16	14	14	17	39	76	62	73	51	52	19	457
Cases.....	9	4	1	3	1	3	9	16	15	18	15	5	99
Deaths...													
Civil population													
Yellow fever. Deaths...	6	6	0	5	6	10	19	52	58	35	37	30	264

1880--1892

[illegible]





resistant

